



Euphrasia crassiuscula subsp. *glandulifera* Thick Eyebright

Taxonomy

Euphrasia crassiuscula subsp. *glandulifera* W.R. Barker

Three subspecies of *Euphrasia crassiuscula* have been recognised: subsp. *crassiuscula*, subsp. *glandulifera*, and subsp. *eglandulosa*. All three subspecies are endemic to mountain areas in the Victorian Alps. They are distinguished from other Australian species of *Euphrasia* in having a conspicuous dense long woolly fringe of eglandular hairs, which often lines the leaves, bracts and calyces. *E. c.* subsp. *glandulifera* differs from subsp. *eglandulosa* in having dense hairs surrounding the anther connective, a feature which is shared also by subsp. *crassiuscula*. However, while *E. c.* subsp. *crassiuscula* does not have glandular hairs, except on the corolla, *E. c.* subsp. *glandulifera* has glandular hairs present on axes and leaves of lower parts, sometimes extending to upper leaves.

Current conservation status

Listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 2003).

Categorised as Vulnerable in the 2014 Advisory list of rare or threatened flora (DEPI 2014).

Proposed conservation status

Critically Endangered in Australia

Criteria B1ab(iii)

Species Information

Description and Life History

The taxon is a perennial, semi-parasitic herb or subshrub, 6-30 cm tall, with many crowded ascending branches rising from a short stem at ground level. Glandular hairs are concentrated on the lower leaves and lower parts of the branches. Leaves are opposite, ovate or elliptic, to 13 cm long and 8 mm wide, with margins bearing 1-3 pairs of teeth. Flowers appear in summer (December to February) and are pale to deep lilac or purple, rarely white. The flowers bear anthers with connectives surrounded by long, usually dense, eglandular hairs. The fruit is an ovoid capsule, slightly compressed laterally, to about 8.5 mm long and 3.2 mm broad (VicFlora 2017).

Little is known of the ecology of high altitude *Euphrasia* species including Thick Eyebright. This taxon, however, is likely to be palatable to livestock. Grazing was excluded from the Mt Nelse population in 1991, and is currently excluded from all known Thick Eyebright sites.

Generation Length

The generation length of *E. c.* subsp. *glandulifera* is inferred to be 25 to 120 years. The generation time is difficult to estimate, given the great uncertainty regarding longevity and recruitment cues, in a subalpine environment in which pre-settlement fire frequencies were likely to occur at the century scale.

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Distribution

The taxon is endemic to Victoria, where it occurs in the north-east near Mt Bogong and Mt Nelse, at high altitudes ranging from 1800 m to 1950 m (Walsh & Entwisle 1999), in the Australian Alps IBRA Bioregion (DEH 2000). Prior to the 2003 bushfires, there were known to be three subpopulations of the taxon, containing about 1300 plants, occurring in the following locations within the Alpine National Park (Carter et al., 2006): Quartz Ridge (west side of walking track from Bogong Creek Saddle to Mt Bogong: about 150 plants in 0.5 ha), Hooker Plateau, Mt Bogong (both sides of walking track between Hooker Plateau and Mt Bogong central: about 450 plants in 9 ha), and Mt Nelse, Bogong High Plains (about 700 plants in 3 ha). At least three additional subpopulations may occur, however these subpopulations have not recently been confirmed. Two subpopulations were affected by the 2003 bushfires (DSE 2008) in which a 50 percent loss of individuals in these subpopulations is estimated to have occurred, however the long-term response of these subpopulations is unknown. The current abundance of the taxon is unknown (TSSC 2016).

In 2000, Neville Walsh estimated a total population size of 100-500 mature individuals in 4-10 subpopulations with a total area of occupancy of 4-10 ha based on observations at three recently confirmed sites (Mt Nelse, Mt Bogong and Rocky Knobs). There was considered to be no evidence of significant population decline or fluctuation. These estimates were revised following field observations of three subpopulations immediately prior to the wildfires of January 2003. Walsh estimated a combined population of 1116-1300 plants for three subpopulations at Mt Nelse, Quartz Ridge and Hooker Plateau (Carter et al. 2003). Two of these subpopulations (Quartz Ridge and Hooker Plateau) were significantly affected by the recent fires and it is not yet known if and how they will recover. It is now apparent that the taxon may have undergone significant decline or fluctuation in area of occupancy, habitat quality, number of subpopulations or population size as a consequence of the recent wildfires. All known sites at which the taxon has been reported are protected within the Alpine National Park.

This subspecies is the most restricted geographically of the three subspecies, all of which are endemic to the Victorian Alps, and it also appears to have the lowest level of occupancy of apparently suitable available habitat. Recent observations by Walsh suggest that the taxon is confined to a very small proportion of the apparently available habitat within the known geographic range. Carter et al. (2003) report that Walsh searched apparently identical habitat to that of known subpopulations on two hills north of Mt Nelse (including Mt Nelse North and an intervening knoll) but no plants of subsp. *glandulifera* were found. The taxon was found to be abundant on eastern aspects of all three hills.

Habitat

The taxon is confined to higher mountain summit areas at an altitude of 1650-1950 metres ASL. The taxon has been recorded in tall alpine herbfield (alpine meadow), margins of low, open to closed, alpine heath and open grassy sites, sometimes on stony terrain. Associated species present at all known recently confirmed sites include *Asterolasia trymalioides*, *Celmisia pugioniformis*, *Grevillea australis* and *Poa hiemata*. Other associated species include *Aciphylla glacialis*, *Craspedia aurantia*, *Craspedia maxgrayi*, *Kunzea muelleri*, *Leucopogon montanus* and *Orites lancifolia*. Soils tend to be shallow alpine loams derived from sedimentary substrata. Topography varies from gentle to steep (c. 10-40 degree) slopes (VicFlora 2017; SAC 2003).

Threats

Continuing decline is inferred from the high rate of mortality reported immediately following the 2003 wildfire, the increasing risk of repeat fire events in the alpine environment which expose resprouting or recruiting populations to targeted browsing by Sambar and recruitment failure due to increasing drought stress. Additional threats identified at some sites include trampling by recreational walkers, weed invasion particularly by *Pilosella aurantiaca* (TSSC 2016; DSE 2008; SAC 2003). The most serious emerging threat is trampling and browsing by Sambar Deer (*Rusa unicolor*), noting that the taxon is likely to be palatable.

The taxon is particularly vulnerable to the effects of stochastic events such as wildfire, on account of its geographic restriction. The threat of wildfire is amply illustrated by the experience of the Bogong Complex wildfires of January 2003 which consumed almost all sites at which the taxon has been recorded. The only subpopulation known with confidence to have survived the fire unburnt is that monitored by Neville Walsh on the western aspect of Mt Nelse. Although the long-term response of the taxon to fire is unknown, Walsh (pers. comm.) reports the apparent loss of all individuals on Quartz Ridge and 66% of individuals on Hooker Plateau. Some lowland *Euphrasia* spp. may require fire for germination or maintenance of habitat, but little is known of the effects of fire on alpine and sub-

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alpine taxa. Recruitment and regeneration of root parasites such as *Euphrasia* spp. is likely to be complicated by dependence on the recovery of associated species such as grasses.

Given the restriction of the taxon to habitats on the highest available alpine summit areas in the Victorian Alps, Climate change is considered to be the most critical threatening process acting upon the population of this taxon in the long term. There is a high risk that global warming could lead to the extinction of this taxon. Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases is listed as a key threatening process under the EPBC Act.

Whilst little is known of the ecology of high altitude *Euphrasia* species, *Euphrasia crassiuscula* is likely to be palatable to livestock. Grazing licences for Mt Feathertop and Mt Loch and for the summit of Mt Bogong were terminated in 1956 and grazing has been excluded from Mt Nelse since 1991. Other sites on the Bogong High Plains to the south of Mt Nelse continue to be grazed and stock are known to wander into grazing exclusion zones such as those on Mt Nelse and Mt Bogong from time to time. All subpopulations of the taxon thus continue to be at greater or lesser risk from grazing by stock. There is also a low threat of weed invasion at sites close to walking tracks since seeds are accidentally dispersed by recreational walkers, a risk posed also by stock movements across the high plains (TSSC 2016; DSE 2008; SAC 2003).

IUCN Criteria

Criterion A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p>A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p style="text-align: center;">based on any of the following:</p> <p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>			

Evidence:

Ineligible under Criterion A

There is insufficient evidence to determine whether there has been or will be a reduction in population sufficient to meet any threshold for Criterion A.

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Criterion B. Geographic range in the form of either B1 (extent of occurrence) and/or B2 (area of occupancy)			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Eligible under Criterion B1 as Critically Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 12 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA). The EoO has been made equal to the AoO to ensure consistency with the definition of AoO as an area within EoO.

The taxon is estimated to be severely fragmented, and is estimated to have 1 location. It has a continuing decline in (iii) above, inferred from the effects of the 2003 wildfire, the increasing risk of repeat fire events in the alpine environment, browsing by Sambar and increasing drought stress. Additional threats identified at some sites include trampling by recreational walkers, weed invasion and trampling and browsing by Sambar.

The taxon is severely fragmented naturally at the landscape scale, since there are no known dispersal mechanisms for the taxon.

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 12 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA. As above, it is estimated to be severely fragmented, to have 1 location, and a continuing decline in (iii) above.

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Criterion C. Small Population size and decline				
		Critically Endangered	Endangered	Vulnerable
Number of mature individuals		< 250	< 2,500	< 10,000
AND at least one of C1 or C2				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2	An observed, estimated, projected or inferred continuing decline AND least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Ineligible under Criterion C

It is estimated that there are 500 to 2,000 individuals, but other thresholds under this criterion have not been met.

Numbers are based on an estimate of 1116-1300 for three subpopulations prior to the bushfires of January 2003.

Two populations were affected by the 2003 bushfires, in which there was an apparent loss of approximately 50% of individuals in these populations (SAC 2003; DSE 2008; TSSC 2016).

Criterion D. Very small or restricted populations				
		Critically Endangered	Endangered	Vulnerable
Number of mature individuals (observed or estimated)		< 50	< 250	< 1,000
D2. Only applies to the VU category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time.		-	-	D2. Typically: AoO < 20 km ² or number of locations ≤ 5

Evidence:

Eligible under criterion D as Vulnerable

The taxon is estimated to be very restricted.

Criterion E (Quantitative Analysis) was not addressed as the taxon does not have a detailed Population Viability Analysis.

References

Carter, O., Walsh, N. & Murphy, A. H. (2006). *National Recovery Plan for the Thick Eyebright Euphrasia crassiuscula subspecies glandulifera*. Department of Sustainability and Environment. Victorian Government, Melbourne.



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DEPI (2014). *Advisory list of rare or threatened plants in Victoria - 2014*. Department of Environment and Primary Industries, Melbourne.

DSE (2008). Action Statement - Thick Eyebright *Euphrasia crassiuscula* subsp. *glandulifera* (No. 230). Department of Sustainability and Environment, Melbourne. Retrieved from:
https://www.environment.vic.gov.au/__data/assets/pdf_file/0020/32690/Thick_Eyebright_Euphrasia_crassiuscula-glandulifera.pdf

SAC (2003). Flora and Fauna Guarantee Scientific Advisory Committee: Final Recommendation on a Nomination for Listing. Nomination No. 702 *Euphrasia crassiuscula* subsp. *glandulifera*. Department of Environment and Primary Industries, Victoria.

TSSC (2016). Conservation Advice *Euphrasia crassiuscula* subsp. *glandulifera* Thick eyebright. Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra. Retrieved from:
<http://www.environment.gov.au/biodiversity/threatened/species/pubs/21556-conservation-advice-01042016.pdf>

VicFlora (2017). Flora of Victoria, Royal Botanic Gardens Victoria: *Euphrasia crassiuscula* subsp. *glandulifera*
Retrieved from: <https://vicflora.rbg.vic.gov.au/flora/taxon/81624853-9cbb-4b64-ade0-746434e44fc7>